Gering-Fort Laramie Irrigation District
Tunnel #1, #2 and #3 Rehabilitation

Gehring-Fort Laramie Irrigation District
Annual Meeting
March 5, 2020

Anderson Consulting Engineers, Inc.

Tunnel #1 and Tunnel #2

Original Design Information

- Constructed in 1917
- Design Flow of 1,420 cfs
- Configuration: 14-ft diameter modified horseshoe
- Open channel-2 feet of air gap on top of tunnel
- 2700 ft length (Tunnel #1)
- 2150 ft length (Tunnel #2)

Tunnel #3

Original Design Information

- Constructed in ????
- Design Flow of 620 cfs
- Configuration: 10.25-ft diameter
- Open channel-air gap on top of tunnel
- 6500 ft length

Tunnel #2-Failure Summary

- Failure on July 17, 2019
- Flow in canal estimated at 1,350 cfs
- Tunnel collapse, 1000 ft of debris blockage
- Sink hole in overburden
- Upstream canal breach due to blockage

SINKHOLE PHOTO #1

SINKHOLE PHOTO #2

SINKHOLE PHOTO #3

SINKHOLE PHOTO #4

CANAL BREACH PHOTO #1

CANAL BREACH PHOTO #2

CANAL BREACH REPAIR-PHOTO #1

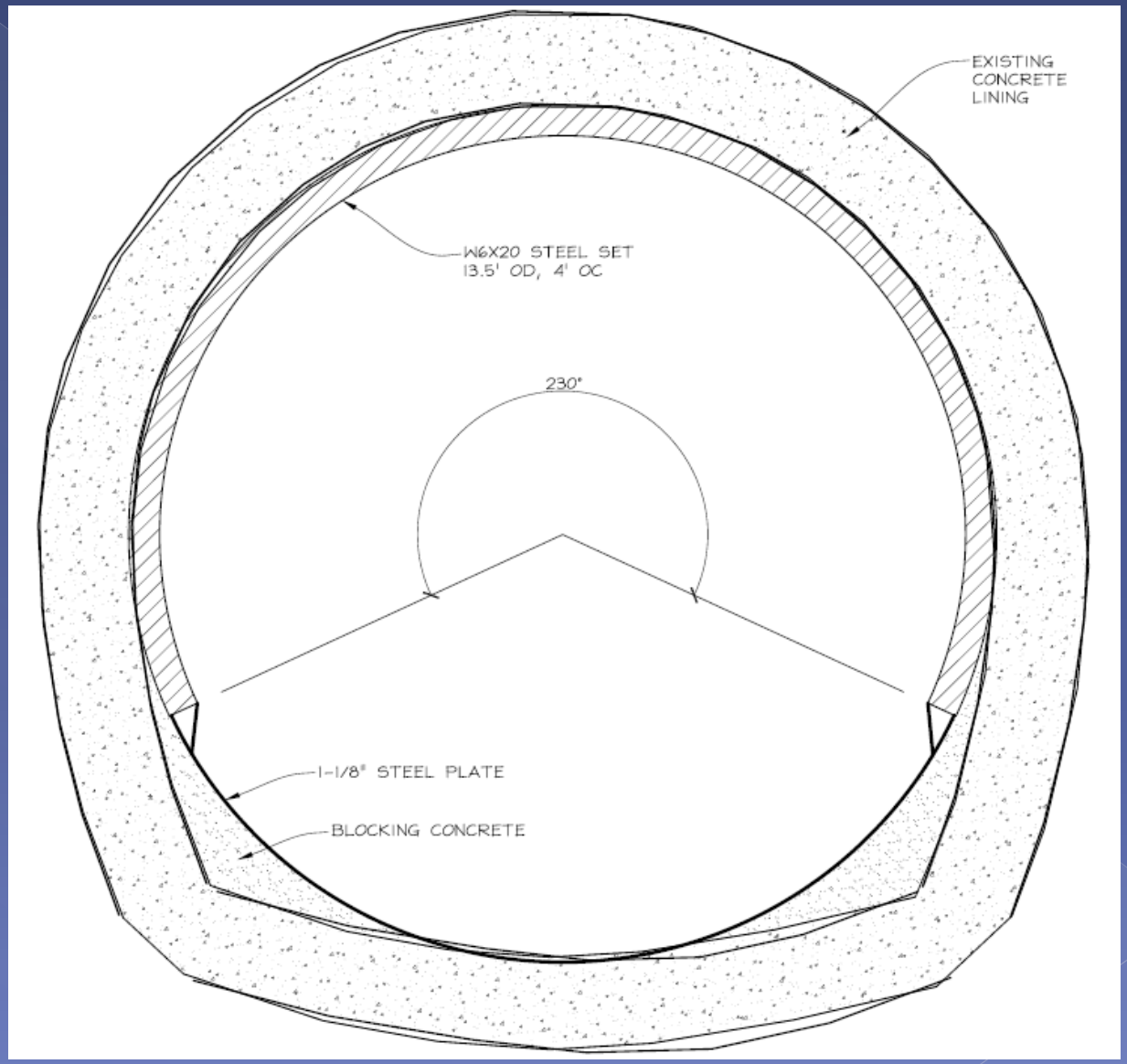
CANAL BREACH REPAIR-PHOTO #2

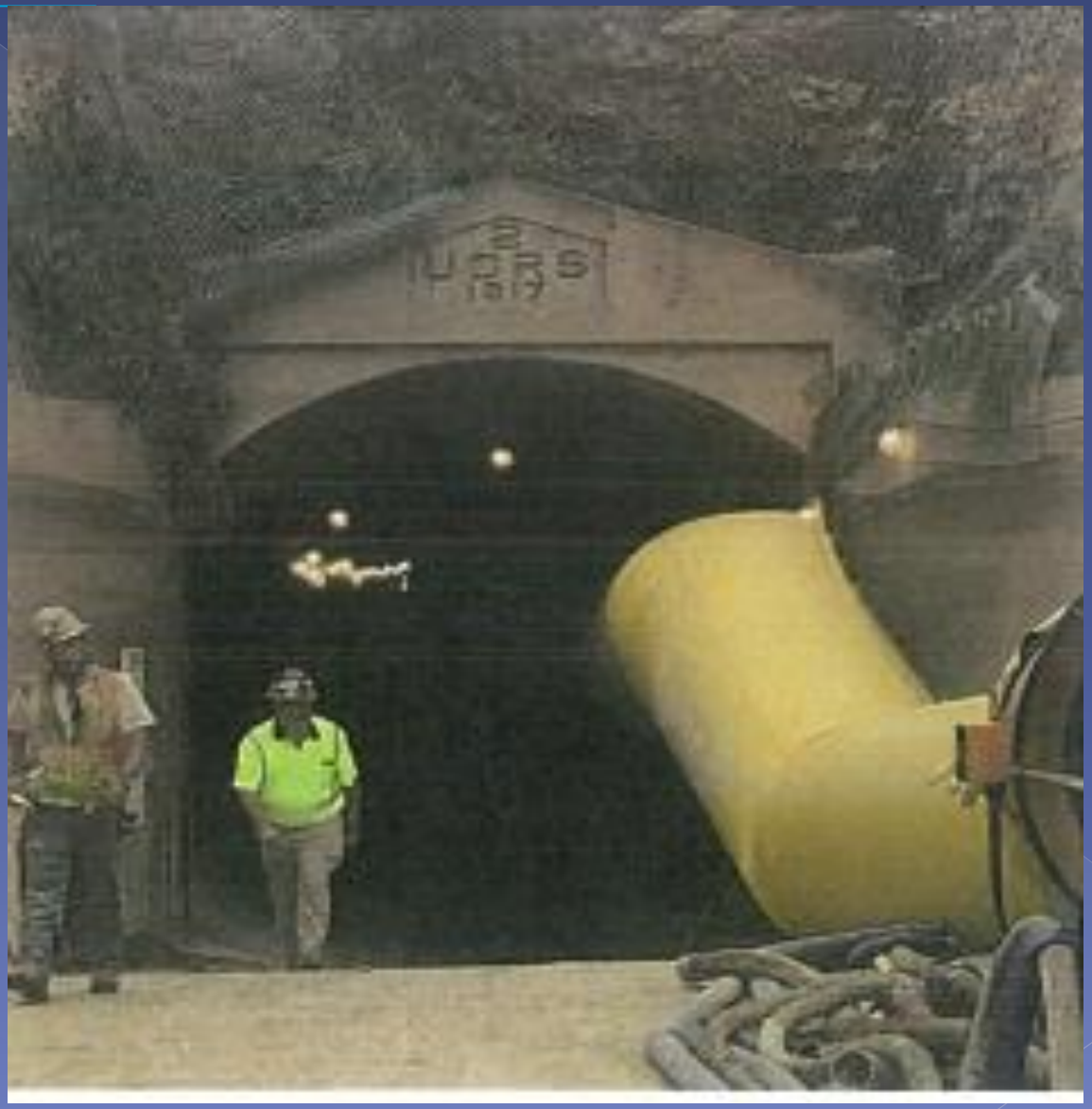
CANAL BREACH REPAIR-PHOTO #3

TEMPORARY REPAIR OF TUNNEL #2

- SAK, Inc. contacted to perform inspection/remediation
- Inspection identified the following remediation efforts:
  - ✓ Placement of Steel Ribs to Support Tunnel Section
  - ✓ Reinforcement of Roof in Collapsed Section
  - ✓ Backfill Grouting to Fill Voids in Concrete Liner
  - ✓ Removal of Collapsed Material from Tunnel #2
  - ✓ Excavation of Overburden above Collapsed Section
- Completion and Water Conveyed on August 28, 2019

Tunnel Section Support Plan

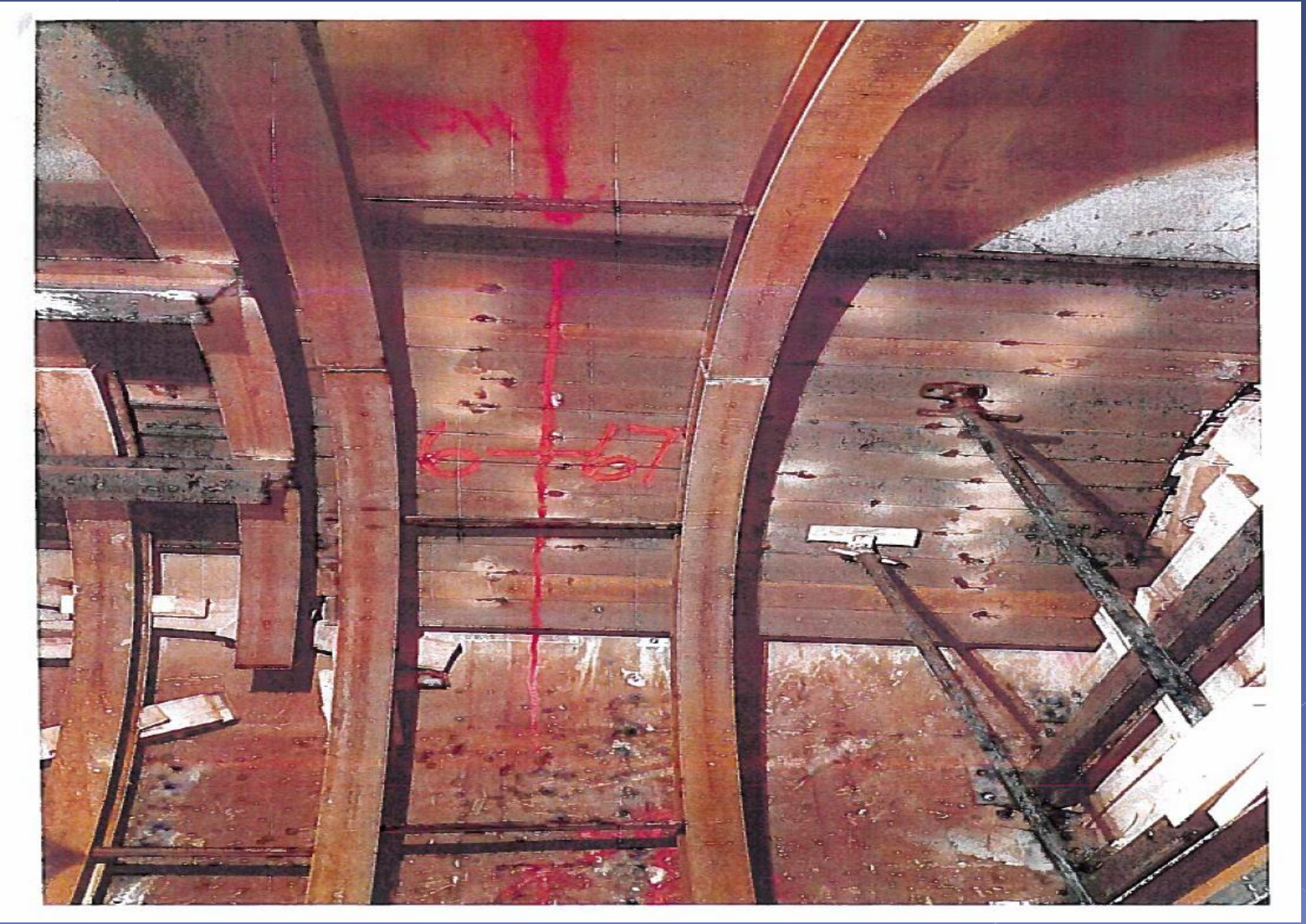




Steel Ribs at 400 feet from Tunnel #2 Inlet

Station 6+20-Bulkhead at First Lining Failure

Steel Ribs & Reinforcement at First Lining Failure



Excavation Above Tunnel #2 Failure

LONG-TERM REPAIR ALTERNATIVES

Summarized in BOR Report in September 2019

- Development of Alternatives (19 identified)
- Determination of Viable Alternatives (10 selected)
- Preliminary Design of Viable Alternatives
- Estimates of Construction Cost and Duration for Alternatives
- Development of Decision Matrix and Ranking
- Results Summary
- Identified Preferred Solution for Tunnels #1, #2 and #3

SELECTED VIABLE ALTERNATIVES (TUNNEL #2)

1. Open Canal on right side of Tunnel #2 (BLM Canal)
2. Open Canal along Existing Tunnel #2 Alignment
3. Install Pipe Through Tunnel
4. Install Pipe Through Tunnel w/Second Parallel Pipe
5. Install Pipe Through Tunnel w/Supplemental Pumping Plant
6. Grouting (backfill and structural) and Fixing Collapsed Sections
7. Grouting, Fixing Collapsed Section and Tunnel Epoxy Lining
8. Steel Sets and Fix Collapsed Sections
9. Steel Sets, Fixing Collapsed Sections and Second Parallel Pipe
10. Steel Sets, Fixing Collapsed Sections, Pumping Plant

EVALUATION AND RANKING OF ALTERNATIVES

Category 1: Quantifiable Criteria

- ✓ Preliminary Costs
- ✓ Flow Capacity
- ✓ Construction Duration

Category 2: Non-Quantifiable Criteria

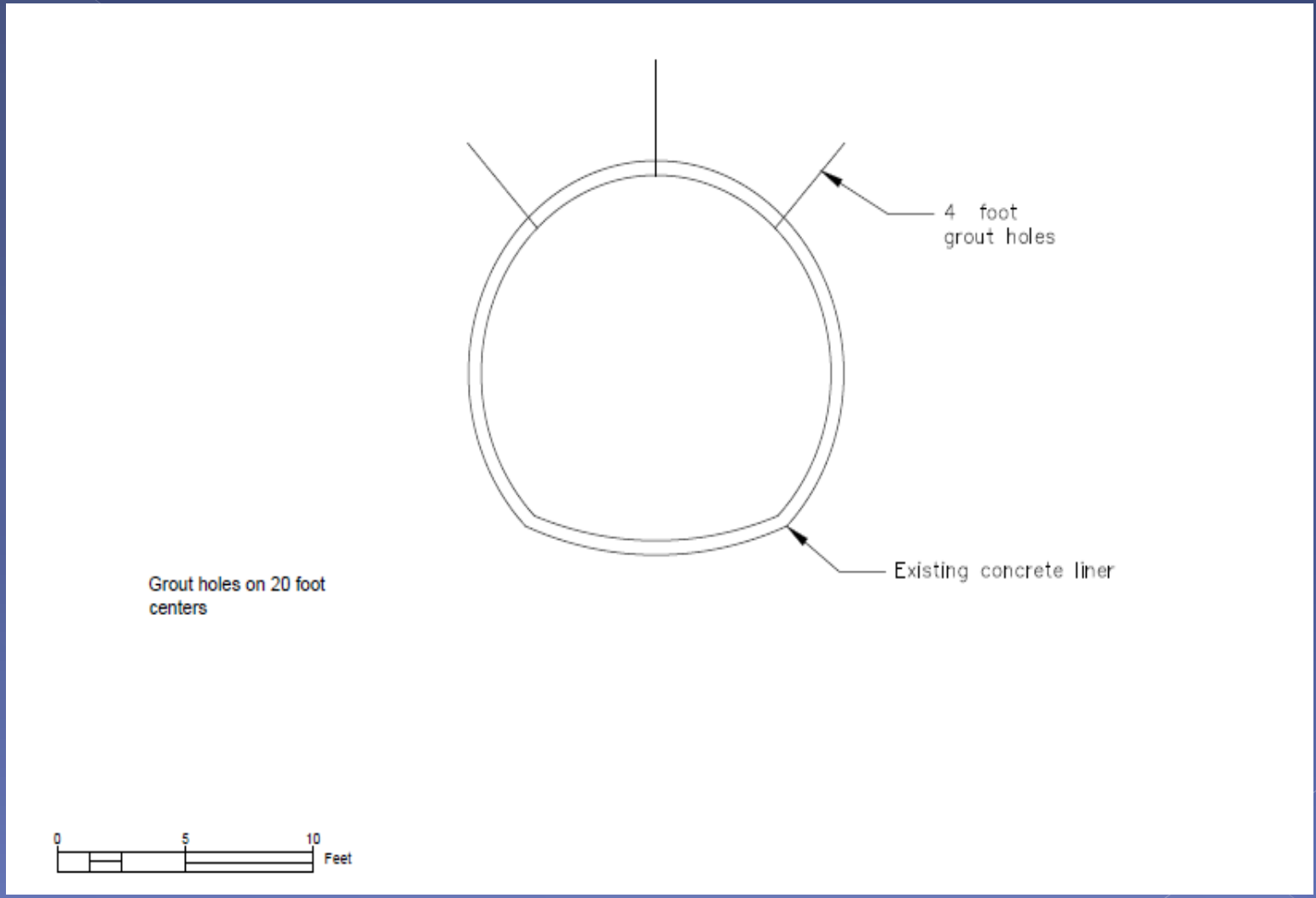
- ✓ Simplicity/Sustainability
- ✓ O&M
- ✓ Environmental Impacts
- ✓ Land Disturbance

BOR PREFERRED LONG-TERM SOLUTION (TUNNEL #2)

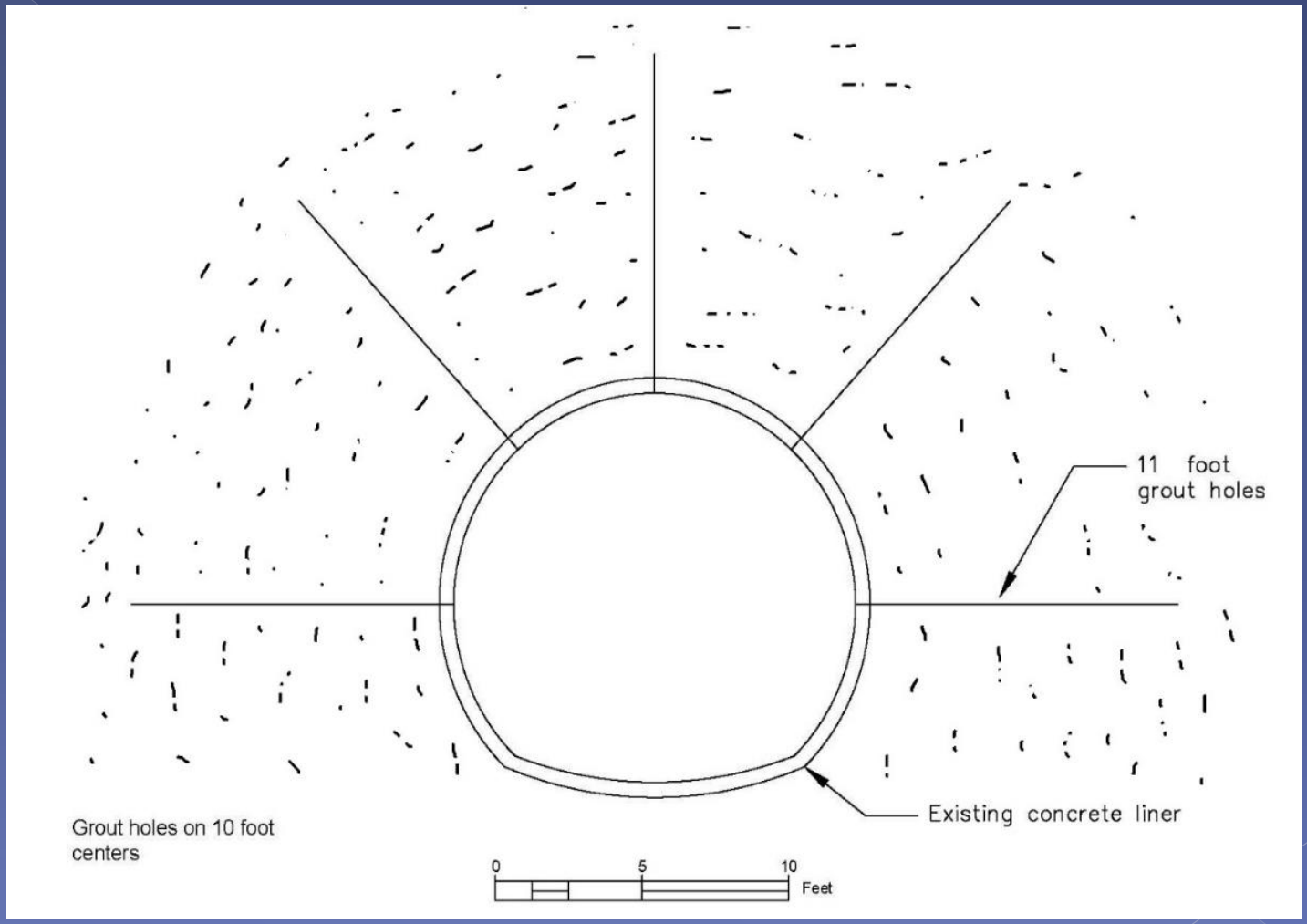
Solution No. 6- Backfill/Structural Grouting, Fix Collapsed Sections

- Further investigation of costs and benefits recommended
- Test grouting required during grouting design
- Integration of steel sets at weak locations

BACKFILL GROUTING DIAGRAM



STRUCTURAL GROUTING DIAGRAM



BOR PREFERRED LONG-TERM SOLUTION (TUNNEL #1)

Solution No. 6- Backfill/Structural Grouting

- Further investigation of costs and benefits recommended
- Test grouting required during grouting design
- Solution includes:
  - Repair of deteriorated tunnel lining
  - Backfill grouting near inlet and outlet portals
  - Installation of steel sets at weak sections

STEEL SETS IN TUNNEL #1

BOR PREFERRED LONG-TERM SOLUTION (TUNNEL #3)

Solution - Open Cut and Install Pipe in portion of Tunnel #3

- Focus on deteriorated portions near inlet/outlet portals
- Consideration should be given to open cut at inlet portal (~ 500 ft) and pipe at outlet portal (~500 ft)
- Inlet portal would require design and replacement
- Flow restrictions are limited with this solution
- Interim solutions involve backfill grouting of voids behind the concrete lining
- Interim solutions require input from qualified grout designer and contractor

SELECTED LONG-TERM SOLUTION (TUNNEL #3)

Solution No. 6- Backfill/Structural Grouting

- Further investigation of costs and benefits recommended
- Test grouting required during grouting design
- Solution includes:
  - Repair of deteriorated tunnel lining
  - Backfill grouting near inlet and outlet portals
  - Installation of steel sets at weak sections

Selection of Long-Term Solutions integrates cost of previous work

FUNDING SOURCES-TUNNELS

DESIGN:

- Pre-Disaster Mitigation Grant (Application submitted)
- Wyoming State Legislature (Awaiting approval)

CONSTRUCTION (Interim Repairs to Date):

- BOR ($4M, 35% Grant/65%L Loan)
- WY SLIB ($4M, 75% Grant/25% Loan)

FUNDING SOURCES-TUNNELS

CONSTRUCTION (Long-Term Solution):

- Pre-Disaster Mitigation Grant (as much as $10M)
- WY State Land Investment Board ($3.5M, 75% Grant/25% Loan)
- WY Water Development Commission (Unknown at this time)
- Nebraska ($3.8 M Grant)
- Nebraska (BOR $2.3 M, 35% Grant/65% Loan)

QUESTIONS?